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Incident Investigation,
Department 233, 3-16-87

March 16, 1987

Incident Investigation
Department 233

TO J. Boehm

General Supts.
Operating Supts.
First Line Supervisors
Engineers
Technicians
R. Murphy (5)

SUMMARY

Date of Incident:	February 5, 1987
Time of Incident:	2:30 p.m.
Location:	Department 233 Sewer Outflow
Type of Incident:	Hot sewers
Most Probable Cause:	Faulty level indicator in Item 203.

Investigating Committee:

Scott Prothero
Ray Reask
Bob Howard
Bob Bunge, Chairman

CER 089152

CONFIDENTIAL 92-CV-204-WDS

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INCIDENT

Hot sewers (vapor measured in excess of 10% of the Lower Explosive Level - L.E.L.) were detected downstream of Department 233 (Monochlorobenzene).

BACKGROUND

In 1981, the MCB Department installed new facilities (MCB Benzene Reduction, CEA 3322) to remove free organics from waste water leaving the department. The waste water facilities contain three major pieces of equipment: Collection Pit, Item 182; Heavy Layer Pump Tank, Item 190; and Collection Tank, Item 187.

The purpose of the Collection Pit is to collect, contain, and gravity separate all process fluids draining from the MCB and Muriatic Acid (Department 218) operating facilities. The Pit is made up of three compartments (Figure 1). The first and northernmost compartment, the Benzene Trap, collects flows from the process drain system. This system includes benzene-contaminated streams coming from the Benzene/ Water Separator, Item 113 (aqueous drain) and Separator Vent Scrubber, Item 131 (effluent), in addition to process equipment drains. The Benzene Trap is level-controlled and pumped to the Collection Tank 187; the Benzene Trap may overflow into the middle compartment of the Pit during high flow conditions or pump/instrument failure.

The second and middle compartment of the Collection Pit, the Middle Pit, receives the flows from the area drains and Department 218. Under design conditions, these flows are relatively low, and the Middle Pit overflows into the third and southernmost Pit compartment, the Pit South End. However, a high load condition can occur when Department 218 is drowning acid, or with a heavy rain or large spill (Figure 2). Under this condition, the South End pit pumps cannot keep up with the flow, and the South End level rises to 100%, stopping overflow from the Middle Pit. At levels above 100%, mid-level contents of the Middle Pit underflow to the plant sewer; this is the first point from which aqueous wastes can exit the process area (Figure 3).

In the Pit South End ,the overflow from the Middle Pit separates into light organic (lighter than water, benzene with some MCB) and aqueous layers, with the potential for a heavy organic layer (heavier than water, mostly MCB). By design, the South End is level-controlled by the heavy layer pumps, which pump the heavy layer to the Heavy Layer Pump Tank 190. The light layer pump pumps the light layer to the Collection Tank 187. As previously mentioned, during periods of high loading, these pumps may become overloaded, and the South End Pit level rises over 100%, stopping overflow and initiating underflow from the Middle Pit to the plant sewer.

The second major piece of equipment of the waste water facilities is the Heavy Layer Pump Tank, Item 190. Most of the collected waste water is pumped to this vessel from the pit. By design, heavy organics can be collected in the bottom dish and transferred intermittently to the Collection Tank 187 or to Separator 113. To date, no heavy layer has

ever been collected in Tank 190. The water phase from Tank 190 overflows continuously to the plant sewer; this is the second point from which aqueous wastes can exit the process area. A nuclear density meter installed in the overflow was designed to divert flow back to the process drains and sound an alarm upon detection of a heavy layer; however, this instrument has been out of service for several years and has never successfully worked.

The third major piece of equipment is the Collection Tank, Item 187. This tank receives waste streams pumped from the light layer pumps (Pit South End) and the Benzene Trap sump pumps (Benzene Trap). Tank 187 is designed to separate the light and heavy organics from the aqueous phase. The light organics layer overflows into the Overflow Receiver, Item 203, for recycling into the process. Any heavy organics layer retained in the bottom of Tank 187 may be pumped to the MCB Rework Tank, Item 523. The aqueous phase underflows continuously to the plant sewer; this is the third point from which aqueous wastes can exit the process area. A nuclear density meter installed in the underflow was designed to divert flow to the process drains and sound an alarm upon detection of either a heavy or light layer, however this instrument has been out of service for several years and has never successfully worked.

DESCRIPTION OF INCIDENT

1. At approximately 2:30 p.m. on February 5, 1987, Powerhouse personnel noticed a benzene odor at their sewers. Vapor testing showed that the sewers were hot, i.e. vapor measured in excess of 10% of the Lower Explosive Level.

2. At 2:50 p.m. a plant emergency was declared.

3. The First Line Supervisor in the MCB Department proceeded to check the underflow from the Collection Pit. No organics were evident by odor or visual observation.

4. The Supervisor then checked the 33E manhole and noticed an odor that he identified as monochlorobenzene.

5. The Supervisor then visually checked the underflow from Collection Tank 187. No organics were observed. The level in the Benzene Overflow Receiver 203 was noted to be at 73%, which was well below full.

6. The Supervisor and the area Production Engineer observed the following control room instrument readings:

   a) Tank 187 LI at 100% - normal
   b) Benzene Trap LI at 60% - normal
   c) Light layer pump flow at 30 GPM - normal
   d) South Collection Pit at 100% - normal.

7. The underflow from Tank 187 was rechecked by sampling and no organics were present. However, two phases were noted to be present in the underflow sight glass.

CER 089154

DESCRIPTION OF INCIDENT CONT'D.

8. The underflow from Tank 187 was then diverted to the Benzene Trap.

9. The bottom of Tank 187 was pumped to the MCB Recycle Tank and was sampled. There were no organics present in the sample, which was noted as unusual because normally MCB would have been present.

10. At that time, it was concluded that the only source of organics causing the hot sewers was the underflow from Tank 187. Benzene was then pumped from Item 203 to the Azeo Column to reduce benzene inventory in the recovery system. The level in Item 203 dropped quickly to 30% and then "shot up" to 100%. The underflow from Tank 187 was noticed to clear up, i.e. only one phase was present.

11. Sometime around 4:00 p.m. the emergency control center told Department 233 to shutdown and eliminate all flows to the sewers.

12. The unit was shutdown and all flows were stopped except for the Department 218 Tank Farm Scrubber.

13. The General Superintendent of the area went to the field to verify the status of the department.

14. The Production Engineer checked the underflow from the Collection Pit and observed benzene in the stream.

15. The water to the 218 Tank Farm Scrubber was shut off.

16. The underflow from the Collection Pit was resampled and was found to be benzene (later analyzed to be 83% benzene and 15% MCB).

17. The water to the 218 Tank Farm Scrubber was turned on as was the water to the Secondary Off-gas Scrubber. The underflow from the Collection Pit then cleared up (no organics were present).

18. The organic level in Tank 187 was measured at 9.0' and the aqueous level at 3.5'.

19. The department was secured in this position and the sewers continued to be monitored and were sporadically hot until about 9:00 a.m. on Friday.

20. The Collection Pit underflow was plugged and the Pit contents were pumped to a trailer. The material was allowed to settle and the water was decanted to the sewer. This operation prevented any benzene from entering the sewer from the Collection Pit on the Thursday late shift.

21. On Friday day shift, wet benzene from Item 203 was sent forward to the Azeo Column for drying. This operation continued until no more benzene flowed to Item 203. Also the vent line and feed line to Item 203 were removed and inspected and found to be okay. The observations in event No. 10 was thought to be due to a blocked line.

CER 089155

DESCRIPTION OF INCIDENT CONT'D.

22. LI's on 187 and 203 were checked and recalibrated. Proper indication was verified.

23. The dip pipe in Item 203 was removed and replaced. The old line was severely distorted.

24. On day shift Saturday, water was introduced to the bottom of Item 187 to force benzene to Item 203. The wet benzene was fed to the Azeo Column until dry benzene storage was full. The wet benzene was then directed to the Benzene Trap. It was then pumped to a trailer, the water was decanted to the sewer, and the benzene was collected in the trailer.

25. This operation continued into late shift until the benzene level in the top of Tank 187 was less than 12 inches as determined by a thief sample.

26. The underflow from Tank 187 was then valved to the sewer, the water flow to Tank 187 was discontinued, and the line from Item 203 to the Benzene Trap was removed.

27. The Pit pumps were started, the Collection Pit underflow sewer plug was removed, and the Department 218 absorber feed water was turned on and directed to the Collection Pit. The sewers were monitored and found to be okay.

28. The water to the HCl drowning jet was turned on (flow goes to the Collection Pit) and again the sewers were monitored and the results were negative with respect to benzene vapors. The Collection Pit level quickly went to over 100% on the LI and was field verified.

29. On day shift the department was started up and the chlorinators were at full rate at about 11:40 a.m.

OBSERVATIONS

1. This incident is the second in 1987.

2. The departmental personnel considered 100% level in the Collection Pit to be normal.

3. Inspection of the overflow and vent between Item 187 and Item 203 indicated each to have good integrity. However, the dip pipe in Item 203 had to be replaced.

4. A tape measurement of Tank 187 showed 3.5' H_2O and 9' organics.

5. The "interface" indicator for Tank 187 is inadequately designed to provide good indication for all the possible interface levels that can occur in Tank 187.

OBSERVATIONS CONT'D.

6. No heavy organic layer was observed in Tank 187 at the time of the incident; a heavy layer at the bottom of Tank 187 is normal.

7. Carbon and sand had collected in the bottom of the Pit.

8. Analysis of organics flowing to the sewer was 83% benzene.

9. Item 203 is routinely emptied when the level reaches 60% per night sheet instructions.

10. The level in Item 203 at the time of the incident was 73%.

11. A high level alarm on 203 is activated at 100%.

12. During the investigation, it was observed the heavy layer pumps could not maintain the desired level in the Collection Pit when the drowning jet was operating. This had become the operating mode two years ago when the drowning jet water bypass was left open to prevent emissions. With shutdown of the cell house, the operating mode was changed to close the water bypass, but the normal pit operating level remained at 100%.

13. The nuclear density meters have been out of service since shortly after the original installation.

14. During the emergency, this series of events contributed to the severity of the incident:

    a) Directing the underflow from Tank 187 to the Benzene Trap caused the Benzene Trap to overflow benzene to the Collection Pit.

    b) Shutting down all flows to the Pit allowed the benzene in the Collection Pit to underflow to the plant sewer.

15. Department personnel expressed the need for additional training on the collection system.

16. Department personnel had different understandings about normal operation of the drowning jet.

17. A hot sewer reading at 33-C1 is considered normal by the department supervision.

18. A means to get a representative sample from the Tank 187 underflow is not available.

19. Design of the Collection Pit allows small amounts of heavy organics to collect in the bottom of the middle section of the Collection Pit. These heavy organics would flow to the plant sewer during a period of high loading to the system.

DISCUSSION

When benzene was pumped to the azeo column from Item 203 (Description of Incident No. 10), the level indicator reading on Item 203 was erratic. Also, the level of the benzene in Tank 187 was measured at about nine feet as compared to a calculated, maximum level, of about three feet.

Instructions are clear, and it is well known in the unit, that Item 203 should be pumped forward when the level reaches 60%. The committee believes that a faulty level reading on Item 203 led to a build up of benzene in Tank 187, which underflowed to the sewer and was the cause of this "hot" sewer incident.

RECOMMENDATIONS

1. Install a sight glass to provide direct visual indication of level in Item 203.

   Responsibility: Maintenance/TSD
   Complete Installation: May 1, 1987

2. Determine the normal interface level in Item 187 via thief sampling and redesign level instruments to give necessary alarming, recording, and verification.

   Responsibility: TSD MAY '88
   Complete Evaluation: ~~August 1, 1987~~
   Complete Installation (if appropriate): TBD

3. Install full flow sampler in Item 187 water underflow line for determination of proper operation.

   Responsibility: Maintenance/TSD
   Complete: June 1, 1987

4. Achieve control of the level in the Collection Pit by one, some, or all of the following:

   a) Clean out Collection Pit and heavy layer pump lines.

   b) Define required pumping rate of the heavy layer pumps to insure level control. Increase pumping rate if necessary.

   c) Define proper operation of HCl drowning jets, i.e. normal water flow rate.

      Responsibility: Manufacturing
      Timing: Complete

CER 089158

RECOMMENDATIONS CONT'D.

5. Evaluate the benefits of a flow system between the Pit South End and Middle Pit for routine transfer of a heavy layer to the South End.

   Responsibility: TSD
   Timing: August 1, 1987

6. Modify log sheets to include, as a minimum, information from equipment provided in Recommendations 1 and 2. Revise operating instructions and retrain operators to include changes implemented.

   Responsibility: Manufacturing
   Complete Revision of Operating Instructions: Within one month of completing Items 1 and 2.
   Complete Operator Training: Within one month of completing Items 1 and 2.

GENERAL

1. Clarify the chain of command to be followed during a plant emergency and evaluate the need for additional authority (in the absence of the Superintendent) at the site of the emergency, i.e. should the General Superintendent of the area involved in the emergency operate at the site?

   Responsibility: PM and Staff
   Timing: Second Quarter 1987

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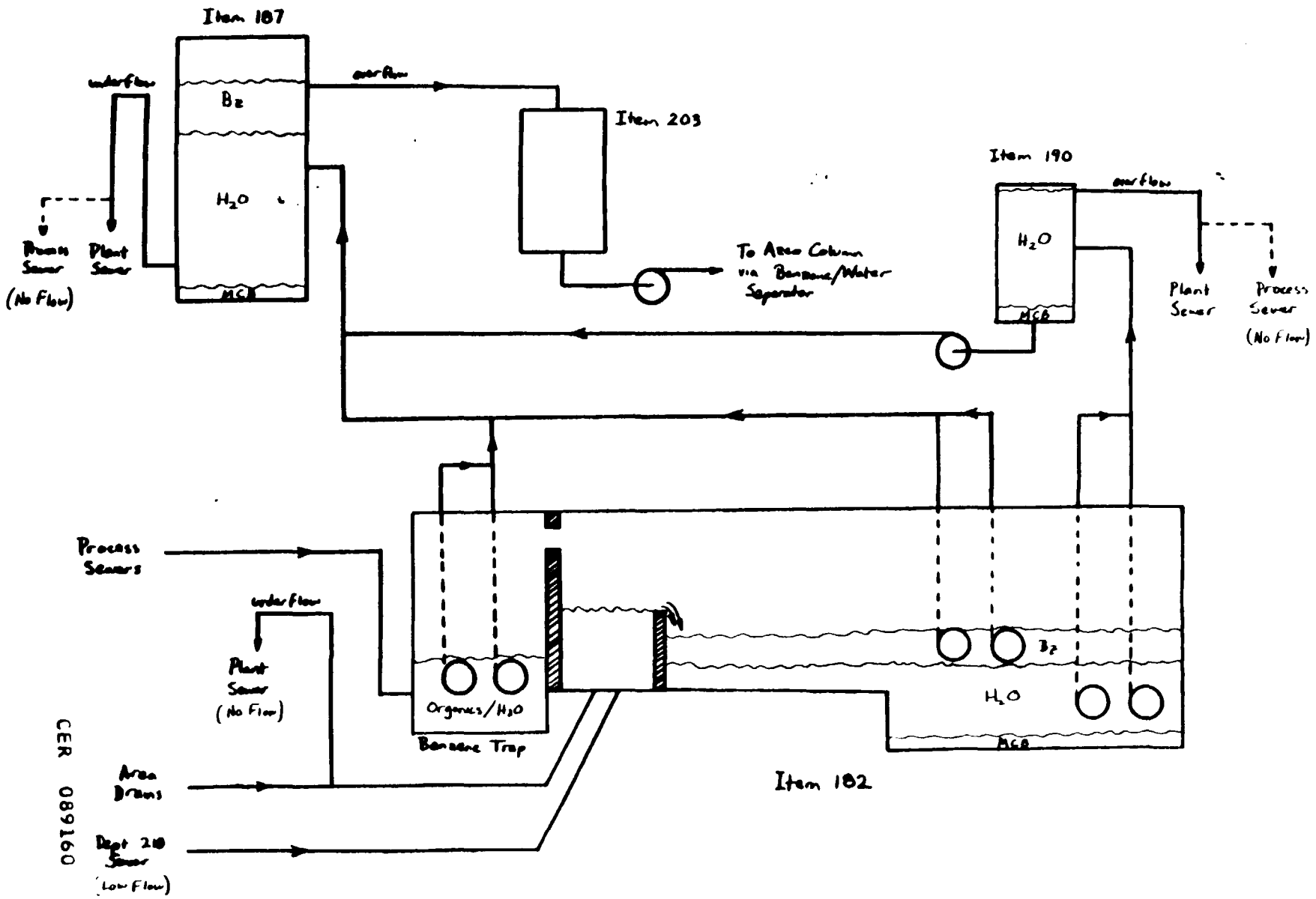
FIGURE 1. DEPT 233 SEWER COLLECTION SYSTEM

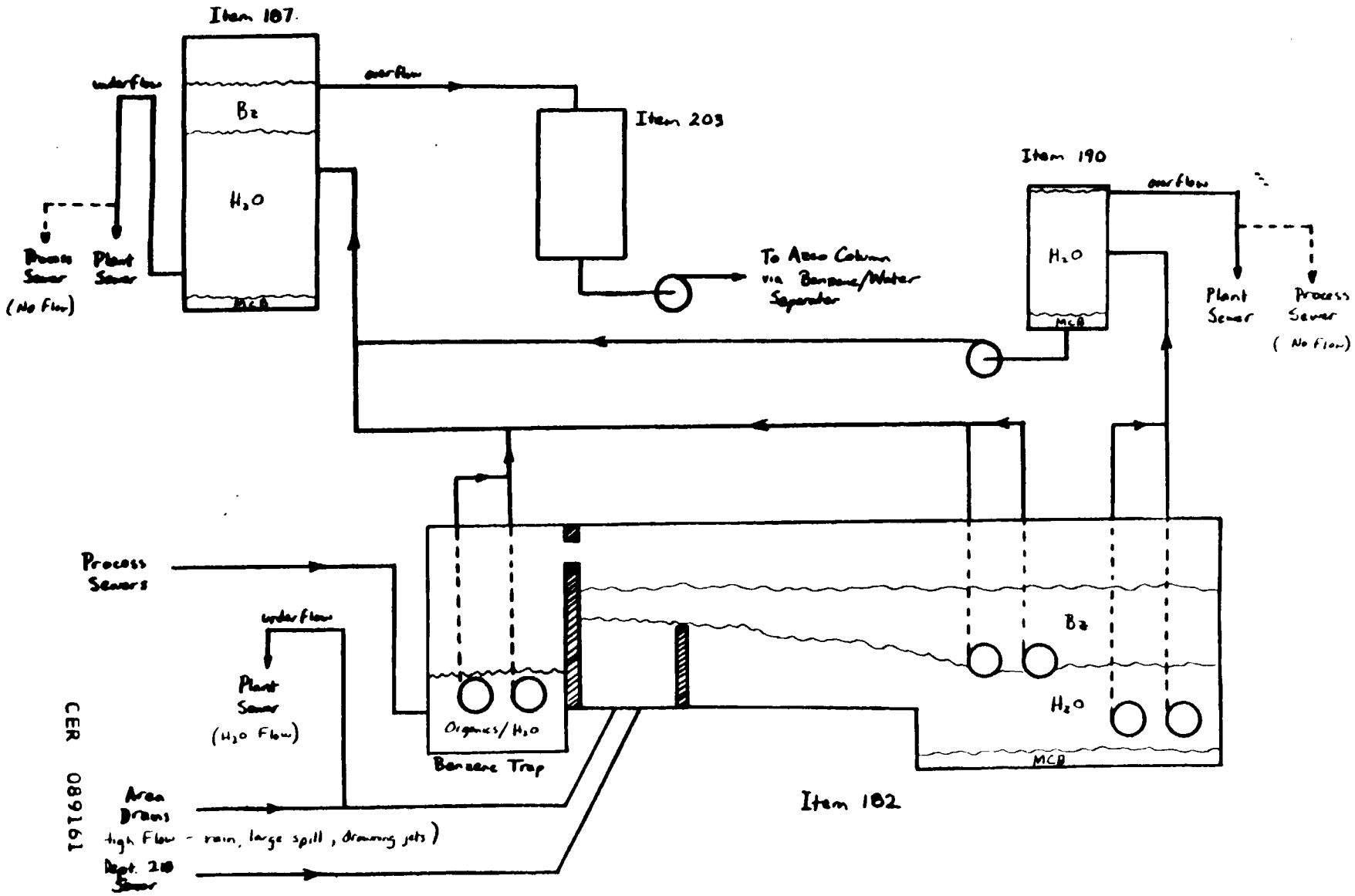
DESIGN OPERATION



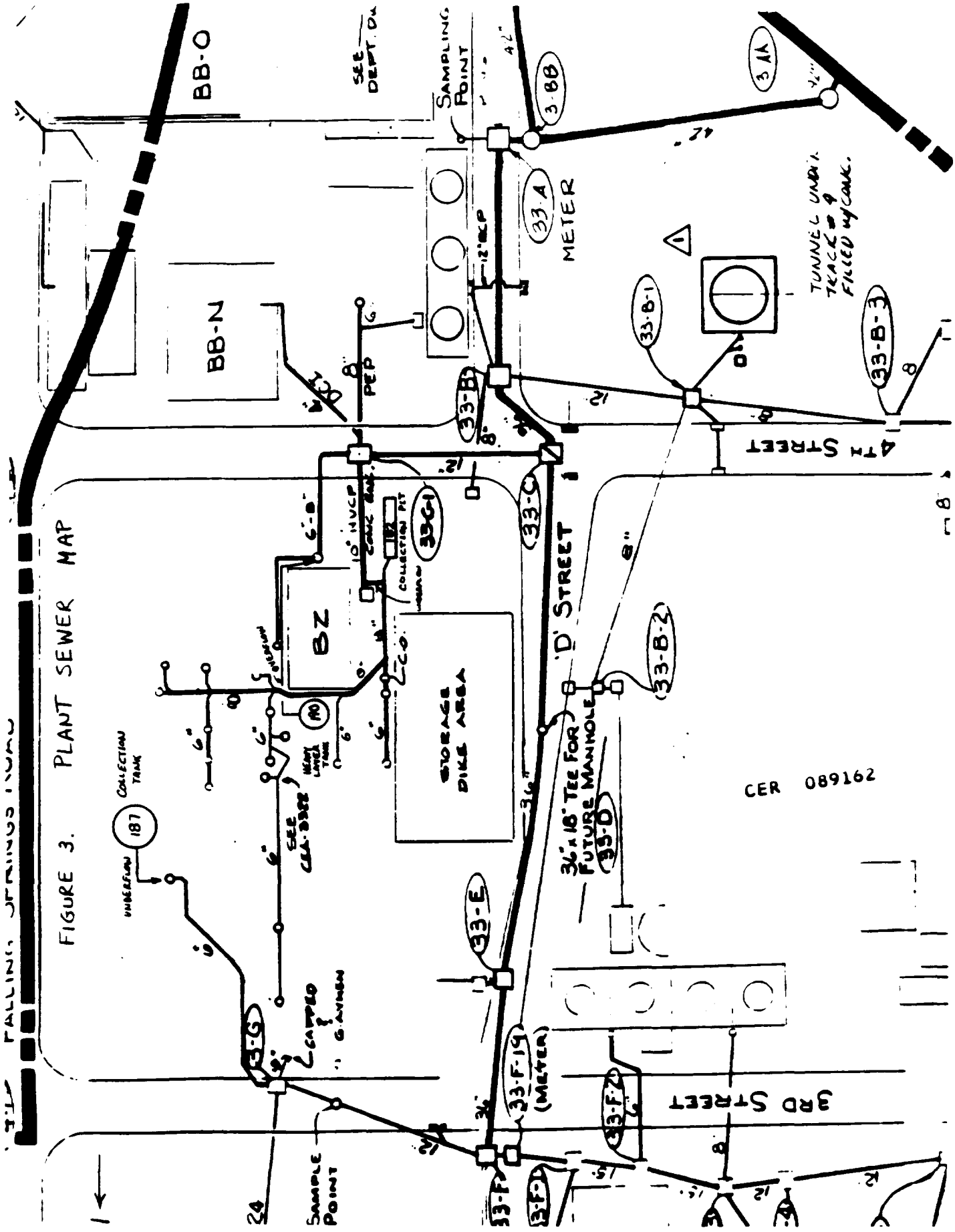
CER 089160

FIGURE 2. DEPT 233 SEWER COLLECTION SYSTEM

HIGH FLOW OPERATION



CER 089161



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